

Amendments to the Claims

This listing of claims will replace all prior versions and listings of the claims in this application.

Listing of Claims

1. (Currently amended) A medical pump for use with a pumping chamber, comprising:
 - a ~~pumping element~~plunger adapted to intermittently pressurize the pumping chamber during a pumping cycle, ~~the pumping cycle defining an attempted fluid delivery stroke of the pump;~~
 - a pressure sensor directly connected to the ~~pumping element~~plunger and adapted to detect the pressure exerted by the ~~pumping element~~plunger on the pumping chamber;
 - a position sensor operatively associated with the ~~pumping element~~plunger to detect the position of the ~~pumping element~~plunger throughout the pumping cycle;
 - a processing unit in electronic communication with the pressure sensor and position sensor;
 - and
 - a memory coupled to the processing unit, wherein the memory contains programming code executed by the processing unit to ~~establish an expected nominal stroke volume associated with the attempted fluid delivery stroke of the pump, set a first stroke frequency based upon a desired dosage rate and the expected nominal stroke volume, thereby, during pressurization of the pumping chamber for at least one attempted fluid delivery stroke, process pressure data from the pressure sensor and position data from the position sensor to determine a calculated actual stroke volume of the pump for the pumping cycle, and, if the calculated actual stroke volume is greater than a given threshold value, to adjust/modify the first stroke frequency of the pump to a second stroke frequency different than the first stroke frequency in order to compensate for variation between the calculated actual stroke volume and the expected nominal stroke volume so as to more closely approach the desired dosage rate during a subsequent pumping cycle;~~ and
- wherein the pumping chamber has a passive outlet valve operated by the pressure exerted by the ~~pumping element~~plunger on the pumping chamber, and the programming code executed by the processing unit processes pressure data from the pressure sensor to identify when the outlet valve has opened.

2. (Original) The medical pump of claim 1, wherein the pressure sensor is the only pressure sensor included in the medical pump.

3. - 8. (Cancelled)

9. (Currently amended) The medical pump of claim 1, wherein the programming code executed by the processing unit processes pressure data and position data to determine a calculated pressurization volume from a beginning of a compression stroke of the pumping cycle to the point when the outlet valve opens, and uses the calculated pressurization volume to determine the calculated ~~actual~~ stroke volume.

10. (Currently amended) The medical pump of claim 9, wherein the programming code executed by the processing unit determines a change in pressurization volume by subtracting the calculated pressurization volume from a nominal pressurization volume, determines a change in stroke volume by multiplying the change in pressurization volume by a ratio of pumping chamber expansion under pressure at the end of the compression stroke to pumping chamber expansion under pressure at the beginning of the compression stroke of the pumping cycle, and determines the calculated actual stroke volume based on the change in stroke volume.

11. (Original) The medical pump of claim 1 further comprising a cassette for defining the pumping chamber.

12. (Currently amended) The medical pump of claim 1, wherein the ~~pumping chamber is pressurized for a plurality of attempted fluid delivery strokes and the calculated actual stroke volume is an average taken over the plurality of attempted fluid delivery strokes, comprises multiple calculated stroke volumes averaged together.~~

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13. - 22. (Cancelled)

23. (Currently amended) A medical pump for use with a pumping chamber, comprising:
a ~~pumping-element~~plunger adapted to intermittently pressurize the pumping chamber during
a pumping cycle, ~~the pumping cycle defining an attempted fluid delivery stroke of the pump;~~
a pressure sensor ~~directly connected to the plunger and~~ adapted to detect the pressure exerted
by the ~~pumping-element~~plunger on the pumping chamber;
a position sensor operatively associated with the ~~pumping-element~~plunger to detect the
position of the ~~pumping-element~~plunger;
a processing unit in electronic communication with the pressure sensor and position sensor;
and
a memory coupled to the processing unit, wherein the memory contains programming code
executed by the processing unit to ~~establish an expected nominal stroke volume
associated with the attempted fluid delivery stroke of the pump, set a first stroke
frequency based upon a desired dosage rate and the expected nominal stroke volume,
thereof, during pressurization of the pumping chamber or for at least one attempted fluid
delivery stroke, process pressure data from the pressure sensor and position data from
the position sensor to:~~
~~set a stroke frequency for a desired dosage rate based on a nominal stroke volume;~~
identify by a slope change in the pressure data when an outlet valve of the pumping
chamber has opened,
determine a calculated pressurization volume from a beginning of the pumping cycle
to the point when the outlet valve opens,
determine a change in pressurization volume by subtracting the calculated
pressurization volume from a nominal pressurization volume,
determine a change in stroke volume by multiplying the change in pressurization
volume by a ratio of pumping chamber expansion under pressure at the end of
the compression stroke of the pumping cycle to pumping chamber expansion
under pressure at the beginning of a compression stroke of the pumping cycle,
determine a calculated actual stroke volume based on the change in stroke volume,
and, ~~if the calculated actual stroke volume is greater than a given threshold
value,~~

~~adjust~~ modify the stroke frequency to a second stroke frequency that is different than the first stroke frequency in order to compensate for variation between the calculated actual stroke volume and the expected nominal stroke volume; and
wherein the outlet valve of the pumping chamber is a passive valve operated by the pressure exerted by the ~~pumping element~~ plunger on the pumping chamber.

24. (Original) The medical pump of claim 23 further comprising a cassette for defining the pumping chamber.

25. (Currently amended) A medical pump for use with a cassette having a pumping chamber, comprising:

a ~~pumping element~~ plunger operatively associated with a shaft and adapted to intermittently pressurize the pumping chamber during a pumping cycle, the pumping cycle defining an attempted fluid delivery stroke of the pump;
a pressure sensor directly connected to the plunger and positioned in-line with the plunger between the pumping chamber and the shaft, the pressure sensor being adapted to detect the pressure exerted by the ~~pumping element~~ plunger on the pumping chamber;
a position sensor operatively associated with the ~~pumping element~~ plunger to detect the position of the ~~pumping element~~ plunger;
a processing unit in electronic communication with the pressure sensor and position sensor;
and
a memory coupled to the processing unit, wherein the memory contains programming code executed by the processing unit to establish an expected nominal stroke volume associated with the attempted fluid delivery stroke of the pump, set a first stroke frequency based upon a desired pump flow rate and the expected nominal stroke volume, hence, during pressurization of the pumping chamber for at least one attempted fluid delivery stroke, to process pressure data from the pressure sensor and position data from the position sensor to determine a calculated actual stroke volume of the pump for the pumping cycle, and to ~~adjust~~ modify the first stroke frequency of the pump to a second stroke frequency different than the first stroke frequency in order to compensate for variation between the calculated actual stroke volume and the expected nominal stroke volume so as to more closely approach the desired pump flow rate for a subsequent pumping cycle; and

wherein the pumping chamber has a passive outlet valve operated by the pressure exerted by the ~~pumping-chamber~~ plunger on the pumping chamber, and the programming code executed by the processing unit processes pressure data from the pressure sensor to identify when the outlet valve has opened.

26. – 30. (Cancelled)

31. (Currently amended) The medical pump of claim 10, wherein the ~~expected~~ nominal pressurization volume comprises multiple nominal pressurization volumes averaged together.